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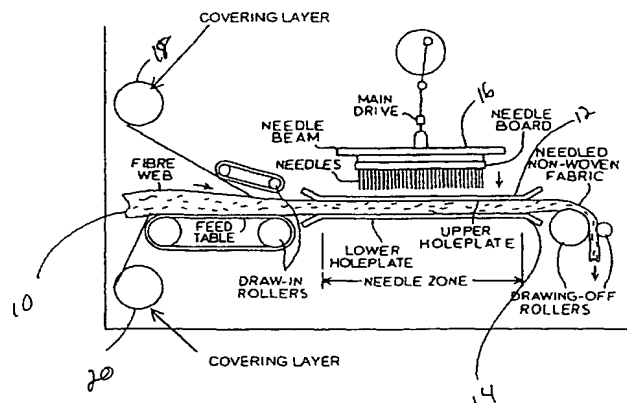
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- (71) Applicant (for all designated States except US): IHC REHABILITATION PRODUCTS [US/US]; 27621 Community Drive, Pinehurst, TX 77362 (US).
- (72) Inventors; and
- (75) Inventors/Applicants (for US only): SLOAN, Mark [US/US]; 6710 Spring Leaf Drive, Spring, TX 77379 (US). BLACKMORE, Richard, D. [US/US]; 5614 Ascalon Circle, Houston, TX 77069 (US). LEPOLA, William, M. [US/US]; 24411 Brautingham, Magnolia, TX 77355 (US).
- (74) Agents: MORNEAULT, Monique, A. et al.; Wallenstein & Wagner, Ltd., 311 South Wacker Drive - 5300, Chicago, IL 60606 (US).
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- Declarations under Rule 4.17:**
- as to the identity of the inventor (Rule 4.17(i)) for all designations
 - as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii)) for all designations

[Continued on next page]

(54) Title: METHOD FOR CONSOLIDATION FOR RANDOM CARBON FIBER ORIENTATION AND FOR FORMING A CARBON FIBER PREFORM



(57) Abstract: The present invention is a method of forming a composite including a carbon fiber layer surrounded by at least a single layer of non-woven fibers both above and below the carbon fiber layer. The layer(s) of carbon fiber and the layers of non-woven fibers are consolidated with a unique needle-punching method. According to another aspect of the invention, the layer(s) of carbon fiber and the layers of non-woven fibers are consolidated with a stitching method. The present invention also provides a method of forming a preform part, comprising a number of steps. First, arrangement of carbon fibers is coated with a binder, which is either a liquid or dry adhesive. Next, the carbon fiber arrangement is placed on a forming surface. The forming surface can be either a curved or generally flat surface. Third, pressure is applied to the carbon fiber arrangement. A vacuum bag or portions of a conventional mold can be used to apply pressure to the arrangement. Lastly, heat is applied to the carbon fiber arrangement to set the binder. Heat can be applied in a number of ways, including applying an electric current to the carbon fibers to resistively heat the carbon fiber arrangement. Once a sufficient quantity of heat has been applied to set the binder, the resulting preform part is allowed to cool and then removed from the forming surface. The preform part is then ready to be injected with resin and used with a mold to form a finished part.

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- as to the applicant's entitlement to claim the priority of the earlier application (Rule 4.17(iii)) for all designations
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For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

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INTERNATIONAL SEARCH REPORT

International Application No

PCT/US 01/17983

A. CLASSIFICATION OF SUBJECT MATTER

IPC 7 D04H13/00 B32B5/26

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 B32B D04H

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the International search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP 0 348 993 A (OSAKA GAS CO LTD) 3 January 1990 (1990-01-03) page 2, line 42,43 page 3, line 28-33 example 1 claims 1,7,10 figure 1	1-3,12, 13
X	US 4 181 513 A (FUKUDA TAKASHI ET AL) 1 January 1980 (1980-01-01) figure 1 column 1, line 65 -column 2, line 23 example 1 claims 1,5,8,9,11	1,5-7,9, 12

☒ Further documents are listed in the continuation of box C.☒ Patent family members are listed in annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

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"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search

12 March 2002

Date of mailing of the international search report

19. 07. 02

Name and mailing address of the ISA

European Patent Office, P.B. 5818 Patentlaan 2
NL - 2280 HV Rijswijk
Tel. (+31-70) 340-2040, Tx. 31 651 epo nl,
Fax: (+31-70) 340-3016

Authorized officer

Stabel, A

INTERNATIONAL SEARCH REPORT

International Application No

PCT/US 01/17983

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	PATENT ABSTRACTS OF JAPAN vol. 014, no. 037 (C-680), 24 January 1990 (1990-01-24) & JP 01 272854 A (OSAKA GAS CO LTD; OTHERS: 01), 31 October 1989 (1989-10-31) abstract ---	1
A	US 3 975 565 A (KENDALL MATTHEW GILES) 17 August 1976 (1976-08-17) column 3, line 50-60 ---	1
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INTERNATIONAL SEARCH REPORT

International application No.
PCT/US 01/17983

Box I Observations where certain claims were found unsearchable (Continuation of item 1 of first sheet)

This International Search Report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:
2. ☐ Claims Nos.:
because they relate to parts of the International Application that do not comply with the prescribed requirements to such an extent that no meaningful International Search can be carried out, specifically:
3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box II Observations where unity of invention is lacking (Continuation of item 2 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

1. ☐ As all required additional search fees were timely paid by the applicant, this International Search Report covers all searchable claims.
2. ☐ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this International Search Report covers only those claims for which fees were paid, specifically claims Nos.:
4. ☒ No required additional search fees were timely paid by the applicant. Consequently, this International Search Report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

1-15

Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest.
- ☐ No protest accompanied the payment of additional search fees.

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

1. Claims: 1-15

Method for forming a composite comprising a layer of carbon fiber being sandwiched by layers of non-woven material (PP, PET, PA or glass fiber; consolidation by needle-punching or stitch-bonding.

2. Claims: 16-41

Method for forming a preform comprising at least one layer of consolidated (binder, needle-punching or stitch-bonding) carbon fiber layer

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PCT/US 01/17983

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